Further Notes on the Identification and Biology of Echeneid Fishes

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Attempts to identify several small echeneid fishes revealed that some of the more useful adult characters are not present in the young. Specifically, disk length, pectoral fin rigidity, body and fin morphology, and scale size and number are features which change with growth. Certain meristic characters were found to be constant over the 14 to 640-mm length range considered, and were usable in identifying small specimens. This paper presents a key to the Echeneidae with further observations on their biology.

The methods employed require only brief description. The leathery membranes were removed from the fins of all but the smallest individuals in order for the rays to be counted. This was particularly necessary for the dorsal fin, the anterior rays of which are recumbent and would otherwise escape detection. The uppermost pectoral ray, a short bony splint, was counted as a ray. Scale examination involved removing a small square of skin from the side below the rear edge of the disk, staining this square with alizarin, and removing the rubbery epidermis. Both lateral line and ordinary scales were then visible in this piece of tissue. No type material was examined, nor was it possible to see specimens of all species. The names used are in accordance with Maul (1956).

Table 1 presents the meristic data obtained from specimens in the collection of the Bureau of Commercial Fisheries Biological Laboratory in Honolulu. These data are the main basis for the following key, although supplementary information was used for the species not seen and to broaden the range of some characters. This information was obtained from the following reports: Bigelow and Schroeder (1953:485–487), Breder (1936:43), Cadenat (1950:265; 1953:674–680), Clemens and Wilby (1949: 329), Clothier (1950:51), Follett and Dempster (1960:172–176), Fowler (1941:269–275), Hildebrand (1946:479), Jordan and Evermann (1898:2268–2273), Krefft (1953:278), Maul (1956), Meek and Hildebrand (1928:896–899), Munro (1955:268), Schultz (1943:258–260), Smith (1950:341–342; 1958:319), and Szidat and Nani (1951:399–407).

The two species of *Remoropsis* recognized by Maul (1956) do not differ meristically, nor are they clearly distinguishable by other means. In general, the body scales of *brachypterus* are large, closely spaced, and superficial, while those of *pallidus* are small, scattered, and embedded. In large *brachypterus,* however, the scales are partially embedded, and, in addition, some *pallidus* have large scales. The shape and spacing of the lateral line scales varies from point to point along the lateral line, and Strasburg (1959: 244) found specimens with the coloration of *pallidus* but the lateral line of *brachypterus.* These facts suggest that *pallidus* and *brachypterus* are very closely related, if not synonymous. In the absence of a definitive monograph, they are retained as distinct species characterized solely by color pattern.

The length of the sucking disk has sometimes been used as a taxonomic character in the Echeneidae (cf Maul, 1956:18). *Rhombochirus* has been distinguished from the other genera, exclusive of *Remilegia,* by the fact that its disk reaches to or past the pectoral tips. The posterior extent of the disk and pectoral fins of echeneids of various lengths is shown in Figure 1. Below 65 mm standard length the pectorals of *Rhombochirus* extend farther posteriorly than the disk, as is always the case with *Remora, Remoropsis,* and *Phtheirichthys.* While this character may be used for large individuals, it

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TABLE 1

FREQUENCY DISTRIBUTION OF MERISTIC CHARACTERS IN CENTRAL PACIFIC ECHENEIDAE

CHARACTERS		NO. OF LAMINAE OR FIN RAYS																															
		9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
disk laminae,	*P. lineatus*	1	7	3																													
	R. osteochir									8	36	9	1																				
	R. remora									13	15	1																					
	R. pallidus							4	7	7	1																						
	R. brachypterus								3	3																							
dorsal rays,	*P. lineatus*																						1		1	1	2		3	1	1		1
	R. osteochir													2	5	13	17	10	6	1													
	R. remora														2	4	12	8	3														
	R. pallidus																				2	3	4	7		3							
	R. brachypterus																				1			4	1								
anal rays,	*P. lineatus*																						1			1	2	1	4	2			
	R. osteochir													1	13	18	15	5	2														
	R. remora														3	19	7																
	R. pallidus																	4	7	7	1												
	R. brachypterus																	2	2	2													
pectoral rays,	*P. lineatus*									1		6	2	1																			
	R. osteochir												1	19	27	7																	
	R. remora																		8	16	4	1											
	R. pallidus																	3	15	1													
	R. brachypterus																	2	2	2													

KEY TO THE ECHENEIDAE

1a. Disk laminae 13 or fewer
  2a. Laminae 9–11, dorsal 30–40, anal 29–38.....*Phtheirichthys lineatus* (Menzies)
  2b. Laminae 12–13, dorsal 16–22, anal 20–26.....*Remorina albescens* (Schlegel)

1b. Disk laminae 14 or more
  3a. Laminae 20–28, usually 21–27
    4a. Dorsal 31–42, anal 30–38.....*Echeneis naucrates* Linnaeus
    4b. Dorsal 20–26, anal 20–26.....*Remilegia australis* (Bennett)
  3b. Laminae 14–20, usually 15–19
    5a. Dorsal 21–27 (usually 22–26), laminae 17–20
      6a. Pectoral 20–23.....*Rhombochirus osteochir* (Cuvier)
      6b. Pectoral 26–29.....*Remora remora* (Linnaeus)
    5b. Dorsal 28–33, laminae 14–18 (usually 15–17)
      7a. Caudal black with white corners in specimens 27–164 mm standard length; dorsal and anal black with white edges, white becoming obsolescent with growth.....*Remoropsis brachypterus* (Lowe)
      7b. All fins uniformly pale colored.....*Remoropsis pallidus* (Schlegel)

TABLE 2

HOSTS OR HABITS OF ECHENEID FISHES

ECHENEID	NO. EXAMINED	STANDARD LENGTH (mm)	HOST OR HABIT
Phtheirichthys lineatus	3	32.8–300	free-living
	5	44.0–55.8	long-line buoy or bait
Rhombochirus osteochir	4	14.3–45.7	free-living
	1	51.2	long-line buoy
	1	48.4	*Acanthocybium solandri*
	4	66.7–85.0	*Tetrapturus angustirostris*
	11	49.8–230	*Makaira audax*
	27	38.5–313	*Makaira ampla*
Remora remora	7	31.3–77.4	free-living
	2	49.3–87.6	*Carcharhinus melanopterus*
	12	50.9–154	*Pterolamiops longimanus*
	1	222	*Prionace glauca*
	1	640	*Rhincodon typus*
Remoropsis brachypterus	1	27.1	free-living
	1	80.0	*Makaira audax*
	2	83.7–112	*Makaira ampla*
Remoropsis pallidus	1	118	free-living
	2	79–83	*Istiophorus orientalis*
	4	116–184	*Makaira audax*
	2	128–152	*Makaira ampla*
	5	128–194	*Istiompax marlina*
Echeneis naucrates	2	50–57 (est.)	*Ostracion lentiginosus* and the author

is clear that *Rhombochirus* shorter than about 65 mm cannot be distinguished from the other genera by the disk length/pectoral length relationship.

Table 2 summarizes the length and host data for the specimens listed in Table 1. Where the host was identified only as "marlin" or "shark" no listing was made in Table 2. Also excluded are three echeneids removed from fish stomachs: a 46-mm *P. lineatus* and a 118-mm *R. pallidus* from *Neothunnus macropterus,* and a 56-mm *R. osteochir* from a "swordfish." The term "free-living" denotes echeneids captured by plankton net, midwater trawl, or dipnet beneath a light.

An aspect of echeneid biology which merits some discussion is the change in habit or host with growth. As shown by Strasburg (1959), attachment tends to be specific with respect to host and attachment site. For example, *Phtheirichthys* is either free-swimming or attached

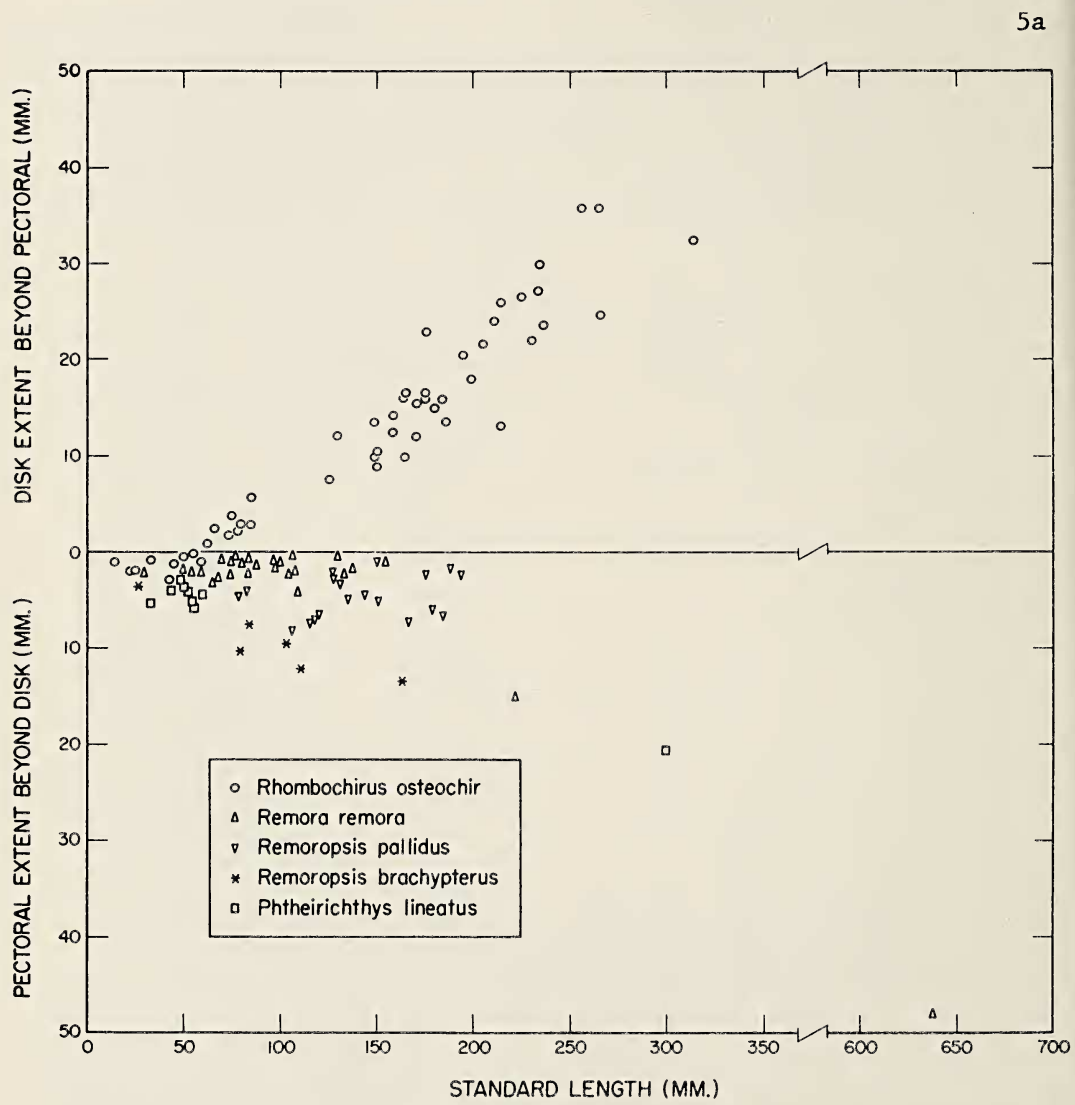

FIG. 1. Relative posterior extent of sucking disk and depressed pectoral fin for various echeneids.

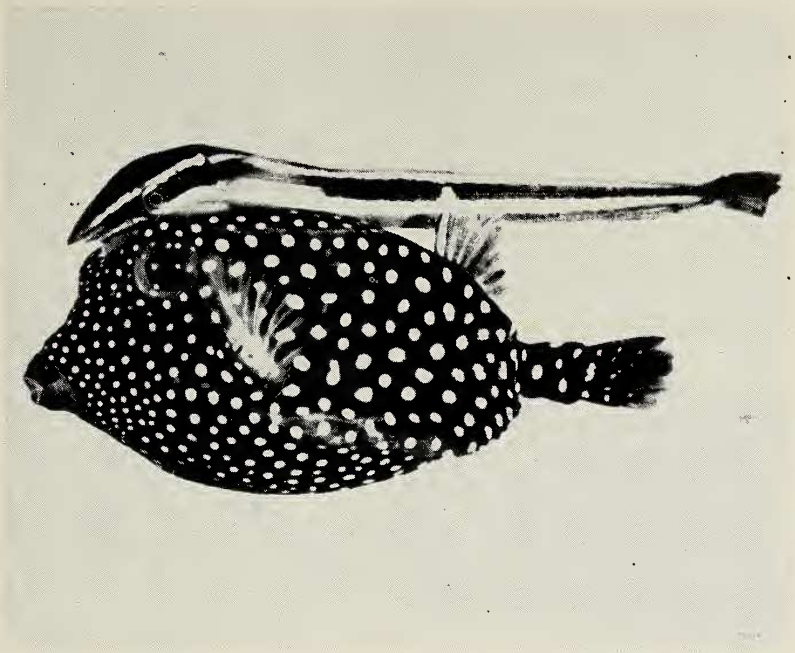

FIG. 2. *Echeneis naucrates* attached to *Ostracion lentiginosus*. Standard lengths estimated to be 57 and 49 mm respectively. (Photograph by Charles E. Cutress, U. S. National Museum.)

to immotile objects, *Remora* is found externally on sharks, and *Remoropsis pallidus* takes refuge beneath the opercula of marlins. Although it is known that the early stages are planktonic, there has hitherto been no information on the size at which attachment first occurs, or whether there are trial hosts.

The material at hand indicates that the transition from the free-swimming to the attached state occurs at about 40–80 mm standard length. *Phtheirichthys* then attaches to immotile objects, as occasionally do some of the others. *Rhombochirus* selects a variety of marlin-like fishes for its attachment, while *Remora* attaches to sharks. One of the *Echeneis* studied was attached to a 49-mm trunkfish, *Ostracion lentiginosus* (Fig. 2), collected on the reef at Waikiki, Oahu, Hawaii. Except for a few brief excursions to the host's belly, it remained inverted as shown. Unfortunately, neither the echeneid nor the trunkfish was preserved, and their lengths are only estimates derived from the relative proportions shown in the photograph. The second *Echeneis* could not be captured but was also about 50 mm in length. It joined me while swimming in 10-ft deep water at Beaufort, North Carolina. Its black and white pattern made it conspicuous, and it was sighted at a distance of 15 ft, swimming directly toward me. The fish made numerous attempts to attach to my black swim fins, touching them but not actually attaching because of my continuous movements. It eluded all attempts to capture it.

It would seem that attachment becomes obligatory somewhere in the 40 to 80-mm length range. Alternate hosts, such as *Acanthocybium, Tetrapturus,* and *Carcharhinus melanopterus,* may then be selected in the absence of the definitive host species. These small hosts may be regarded as trial vehicles because they bear only small echeneids. The size of the echeneids carried by them would be restricted by the relatively fewer ectoparasites available as food or, as in the case of the *Ostracion–Echeneis* association, by problems of list and drag resulting from a bulky adherent.

As a corollary, one would expect large echeneids to select large hosts or, in their absence, to revert to free swimming. The latter appears to be the case with *Echeneis naucrates,* 39-inch individuals of which are free-living around piers at Eniwetok, Marshall Islands (Strasburg, 1957: 60). The 640-mm *R. remora* listed in Table 2 confirms the first part of the hypothesis, for it was one of about three dozen individuals of similar size accompanying a 50 to 60-ft whale shark, *Rhincodon typus,* at Maro Reef (northwest of the main Hawaiian Islands). Attempts to lure this shark to the fishing vessel were unsuccessful because the chopped fish bait was intercepted by the darting remoras. Twelve remoras were caught by pole and line using tuna flesh as bait, but only a single specimen was preserved. Its stomach was empty, unfortunately, so that no light can be shed on its diet. It is doubtful that such a large fish could subsist mainly on its host's ectoparasites (cf Strasburg, 1959:246).

Some of the smaller specimens listed in Table 2 are the smallest reported representatives of their species. The 27.1-mm *brachypterus* is considerably shorter than Gudger's (1928) 77-mm fish, and my 14.3-mm *osteochir* is smaller than his 36-mm specimen. Gudger presents few descriptive data, however, and his specimens seem to differ from what are here called *brachypterus* and *osteochir.* On the basis of pectoral counts, Beebe's (1932) 15-mm *"Remora remora"* is *Rhombochirus osteochir,* while his 88-mm specimen is correctly identified as *R. remora.*

Beebe (ibid.) also misinterpreted certain morphological peculiarities of the lips and jaws of his small *osteochir.* These were stalked cup-like structures which he termed "suckers," and which he postulated were used for host attachment prior to the development of the cephalic disk. Actually the "suckers" on the mandible are the enlarged fleshy sockets which normally bear the fangs, while those on the upper lip are merely large pores. The fangs are easily extracted with forceps, imparting a sucker-like appearance to the supporting tissues. My 14.3-mm *osteochir* has seven outer and two inner fangs on each side of the mandible, making a total of 18 sockets. This is a reasonable approximation of the 20 "suckers" and four fangs which Beebe found in his 15-mm fish.

The young echeneid's need for its relatively enormous fangs is presently inexplicable. These teeth are not deciduous but instead become inconspicuous through overgrowth of the gums and the appearance of other teeth between them.

Its intimate association with another species could impose serious reproductive restrictions on an echeneid. Unless both sexes attached to the same host individual, spawning would be limited to times when the host species aggregated. Echeneids attached to hosts which schooled or congregated to feed would have many opportunities for mating, but those accompanying solitary hosts would have to spawn simultaneously with them.

The material at hand was examined for gonad maturity and the presence of both sexes on the same host individual. Unfortunately, the specimens were not always so segregated that the latter could be determined. Thus, although mature *Remora remora* and *Remoropsis pallidus* were found, it was not certain whether both sexes had been attached to the same shark or marlin. The available *Remoropsis brachypterus* and *Phtheirichthys lineatus* were few and sexually immature.

In contrast to the above, the *Rhombochirus osteochir* data present a relatively clear picture of the physical distribution of the sexes. Thirteen marlin and spearfish bore 2 *Rhombochirus* apiece. In 10 cases the 2 were a male and female of the same size and degree of maturity (7 pairs were judged to be ripe, based on abdominal distension of the female). The 11th pair was a small female and a fish half her size whose sex could not be determined. The remaining 2 couples consisted of young fish of undetermined sex. A 14th host was accompanied by 3 *Rhombochirus,* a ripe male and female and a small individual, one-fourth the length of the others, whose sex could not be ascertained.

With 11 out of 14 pairs bisexual and in the same maturity stage, it would seem that *Rhombochirus* can reproduce quite independently of its host's aggregating habits. This does not mean that it always does so, for mature single *Rhombochirus* were also collected. In such cases, however, there is a possibility that these fish were remnants of pairs the other members of which had detached during the capture of the host.

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